OIPE IAP28
DEC 28 2007
PATENT & TRADEMARK OFFICE

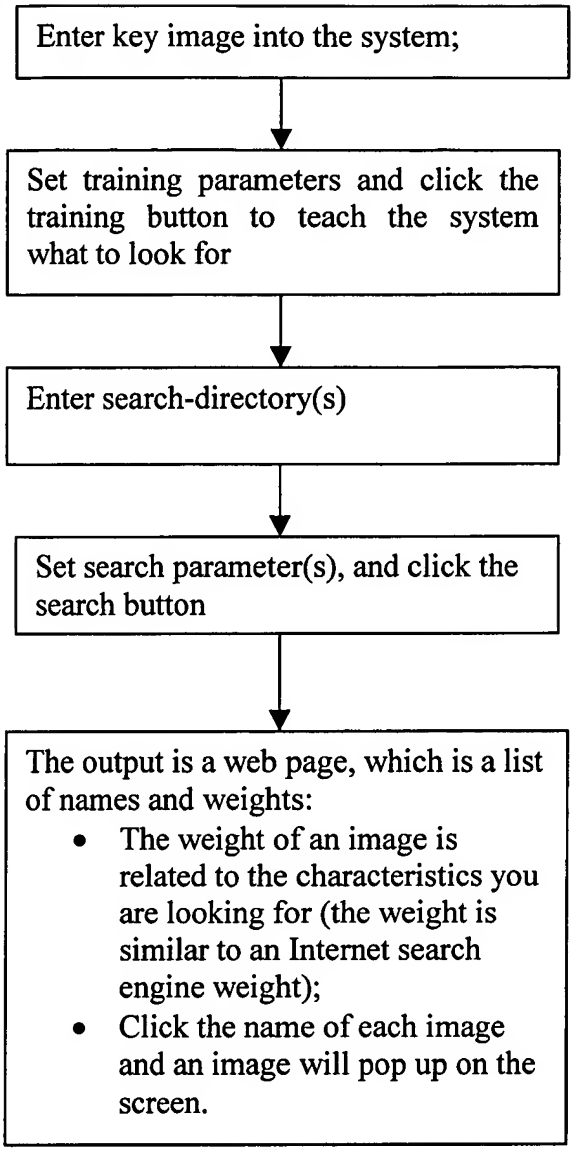


Figure 1.

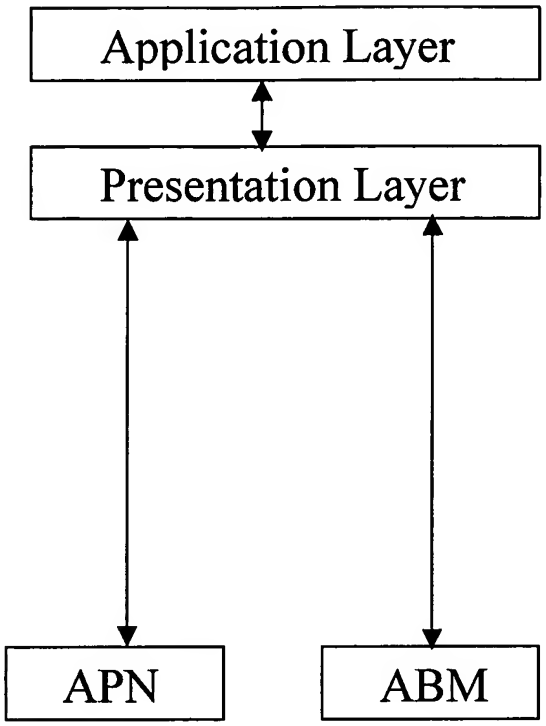


Figure 2.

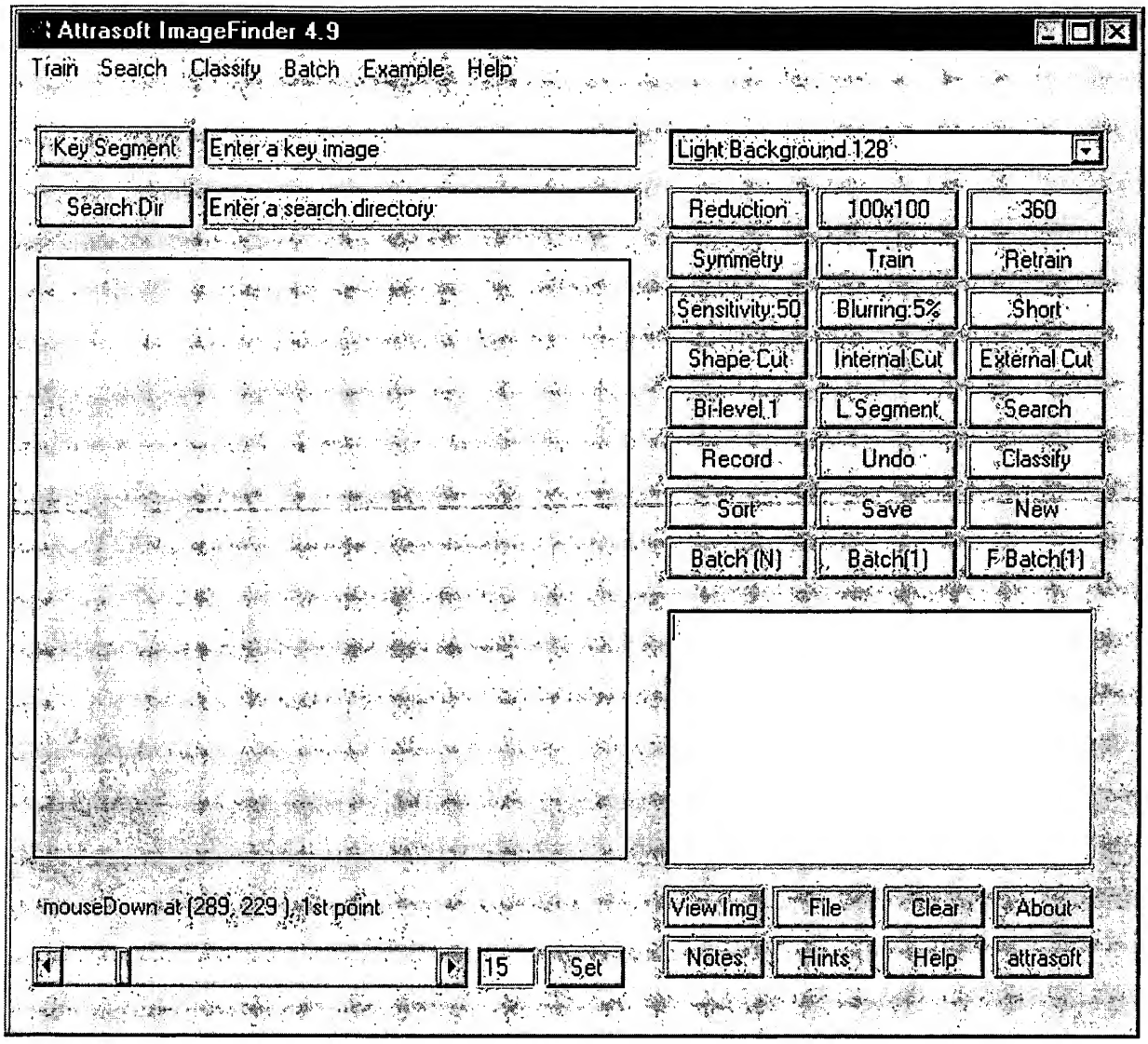
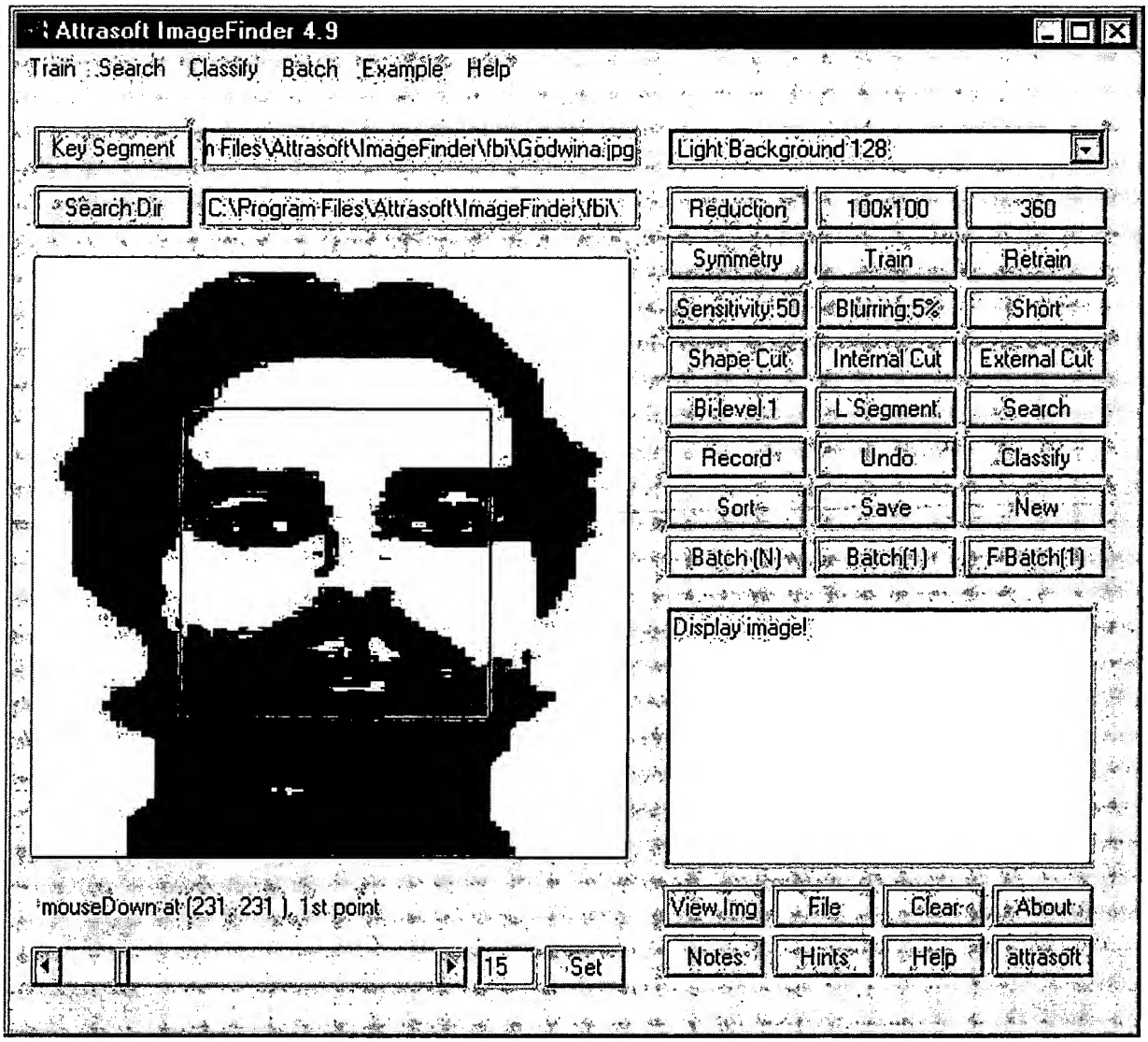

Attrasoft ImageFinder 4.9
Train Search Classify Batch Example Help
Key Segment
Enter a key image
Light Background 128
Search Dir
Enter a search directory
Reduction
100x100
360
Symmetry
Train
Retrain
Sensitivity:50
Blurring:5%
Short
Shape Cut
Internal Cut
External Cut
Bi-level 1
L Segment
Search
Record
Undo
Classify
Sort
Save
New
Batch (N)
Batch(1)
F Batch(1)
mouseDown at (289, 229) 1st point
15
Set
View Img
File
Clear
About
Notes
Hints
Help
attrasoft

Figure 3.


Attrasoft ImageFinder 4.9
Train Search Classify Batch Example Help
Key Segment
n Files\Attrasoft\ImageFinder\fbi\Godwina.jpg
Light Background 128
Search Dir
C:\Program Files\Attrasoft\ImageFinder\fbi\
Reduction
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Symmetry
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Retrain
Sensitivity 50
Blurring 5%
Short
Shape Cut
Internal Cut
External Cut
Bi-level 1
L Segment
Search
Record
Undo
Classify
Sort
Save
New
Batch (N)
Batch(1)
F-Batch(1)
Display image!
mouseDown at (231, 231), 1st point
15
Set
View Img
File
Clear
About
Notes
Hints
Help
attrasoft

Figure 4.

Annotated

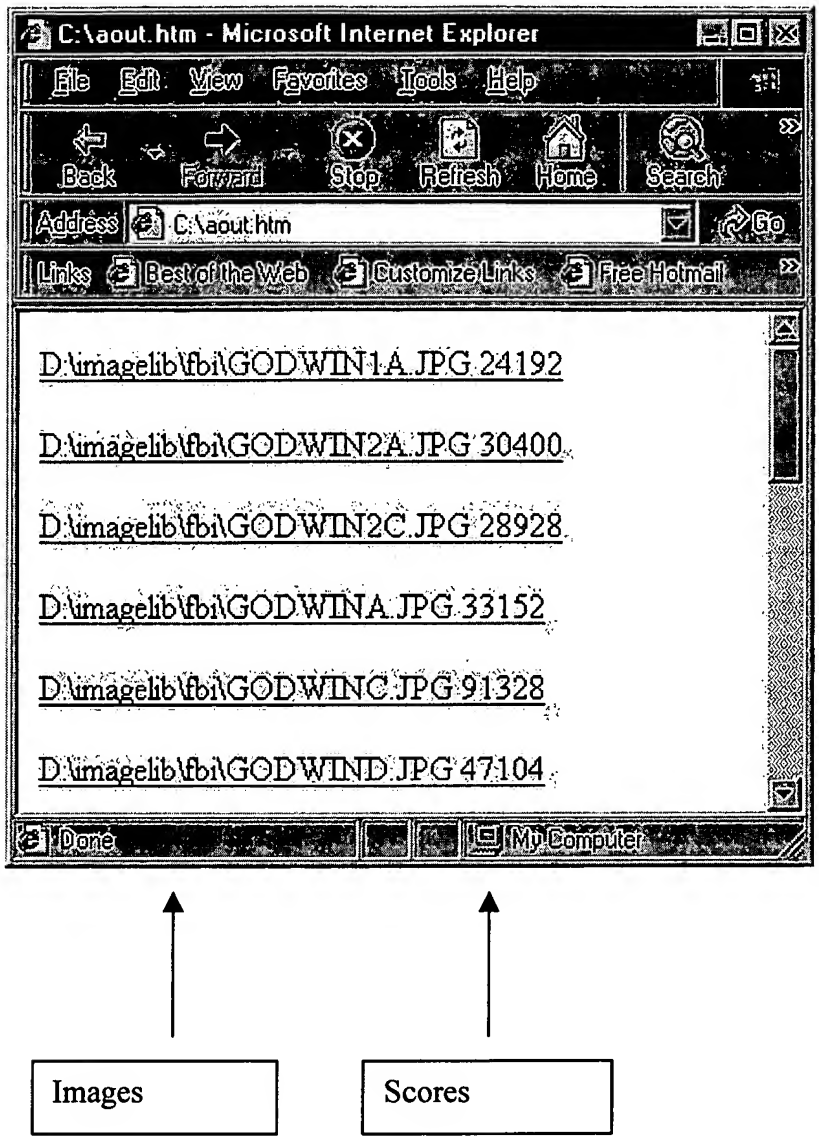


Figure 5.

Annotated

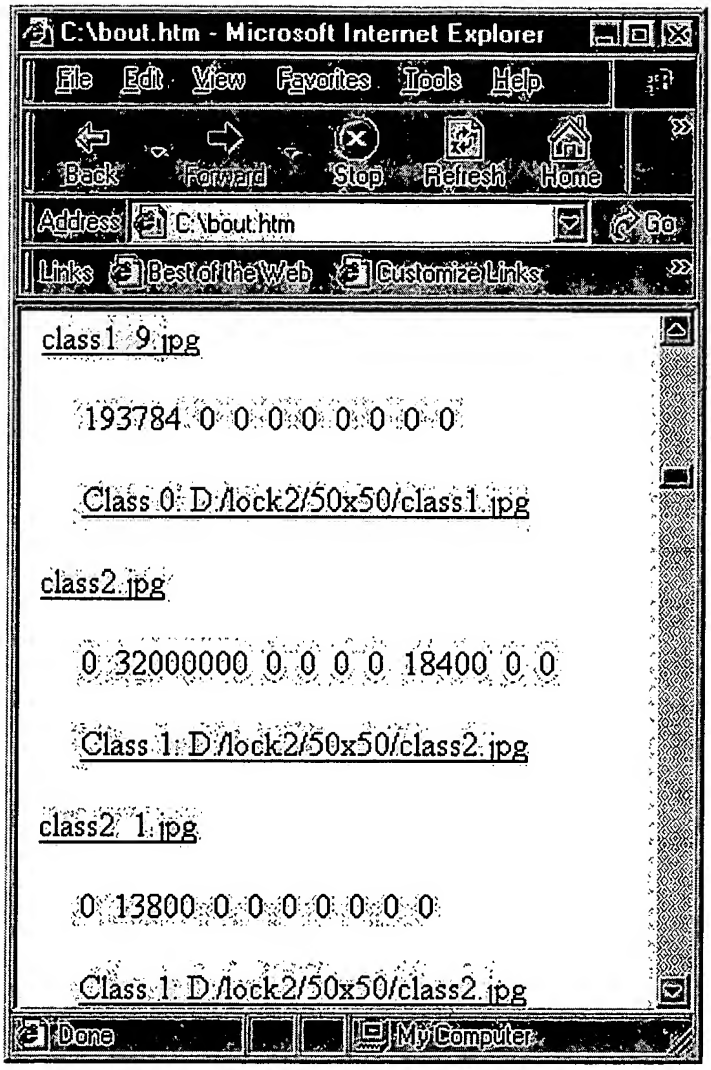


Figure 6.

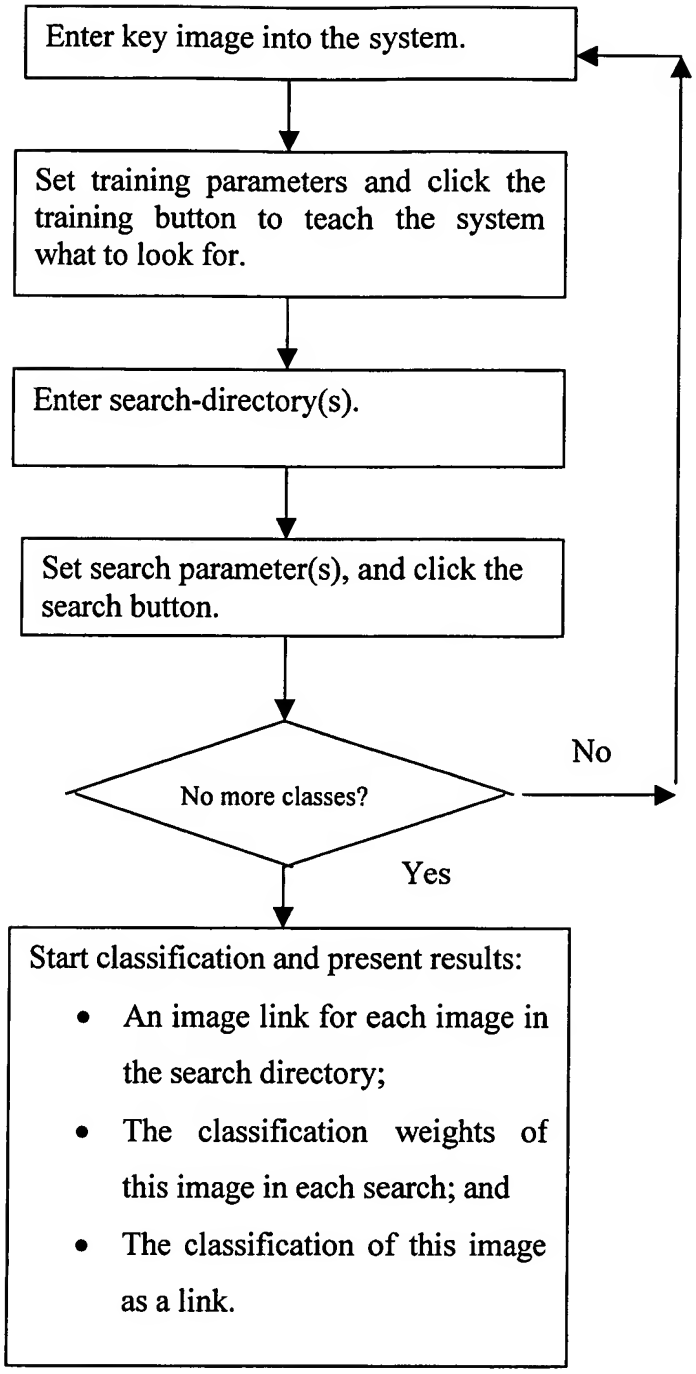

Enter key image into the system.
Set training parameters and click the training button to teach the system what to look for.
Enter search-directory(s).
Set search parameter(s), and click the search button.
No more classes?
No
Yes
Start classification and present results:
• An image link for each image in the search directory;
• The classification weights of this image in each search; and
• The classification of this image as a link.

Figure 7.

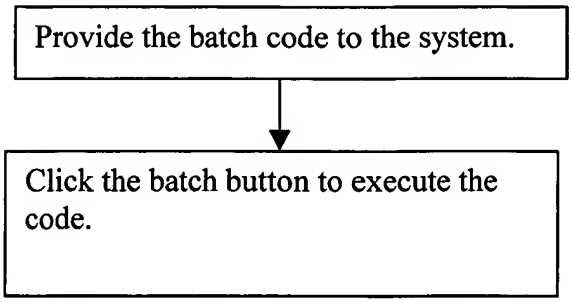

Provide the batch code to the system.
Click the batch button to execute the code.

Figure 8.

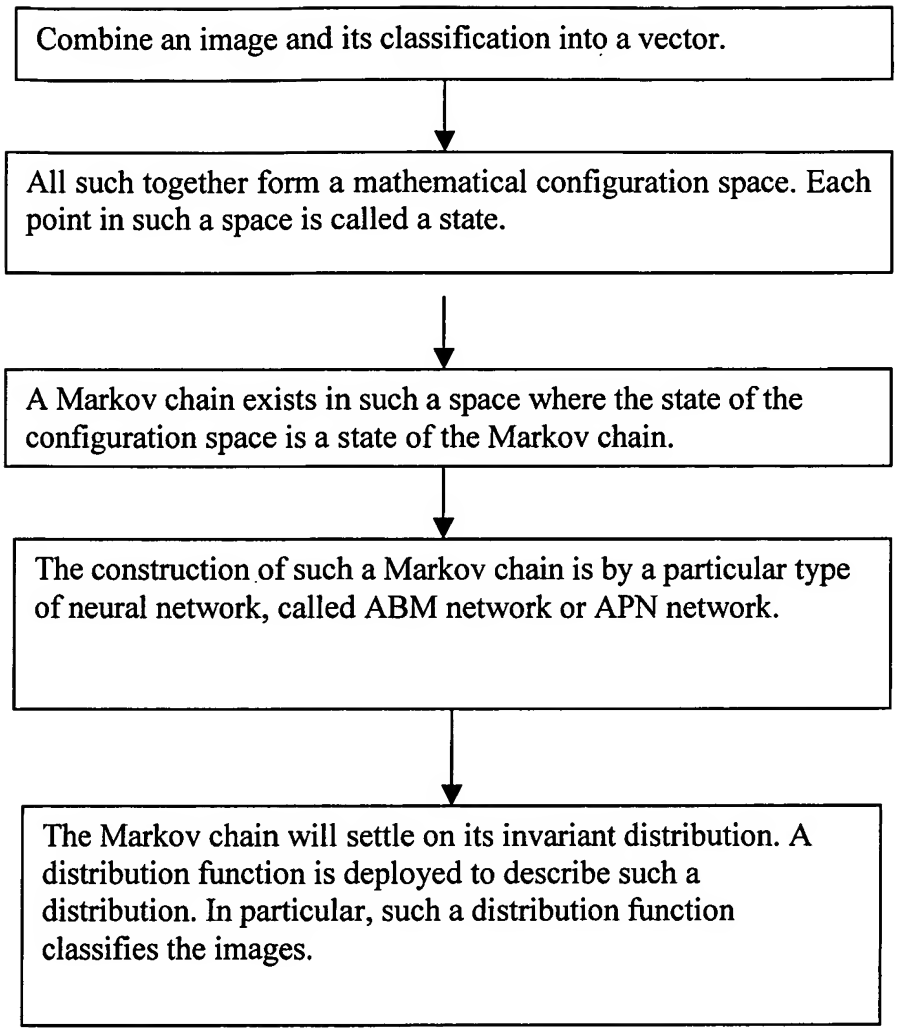

Combine an image and its classification into a vector.
All such together form a mathematical configuration space. Each point in such a space is called a state.
A Markov chain exists in such a space where the state of the configuration space is a state of the Markov chain.
The construction of such a Markov chain is by a particular type of neural network, called ABM network or APN network.
The Markov chain will settle on its invariant distribution. A distribution function is deployed to describe such a distribution. In particular, such a distribution function classifies the images.

Figure 9.

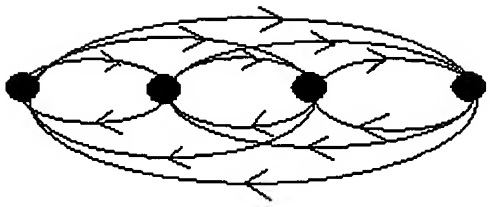


Figure 10.

$$\begin{pmatrix} p00 & p01 & p02 & & p0_15 \\ p10 & p11 & p12 & & p1_15 \\ \cdots & & & & \\ p15_0 & p15_1 & p15_2 & & p15_15 \end{pmatrix}$$

Figure 11.

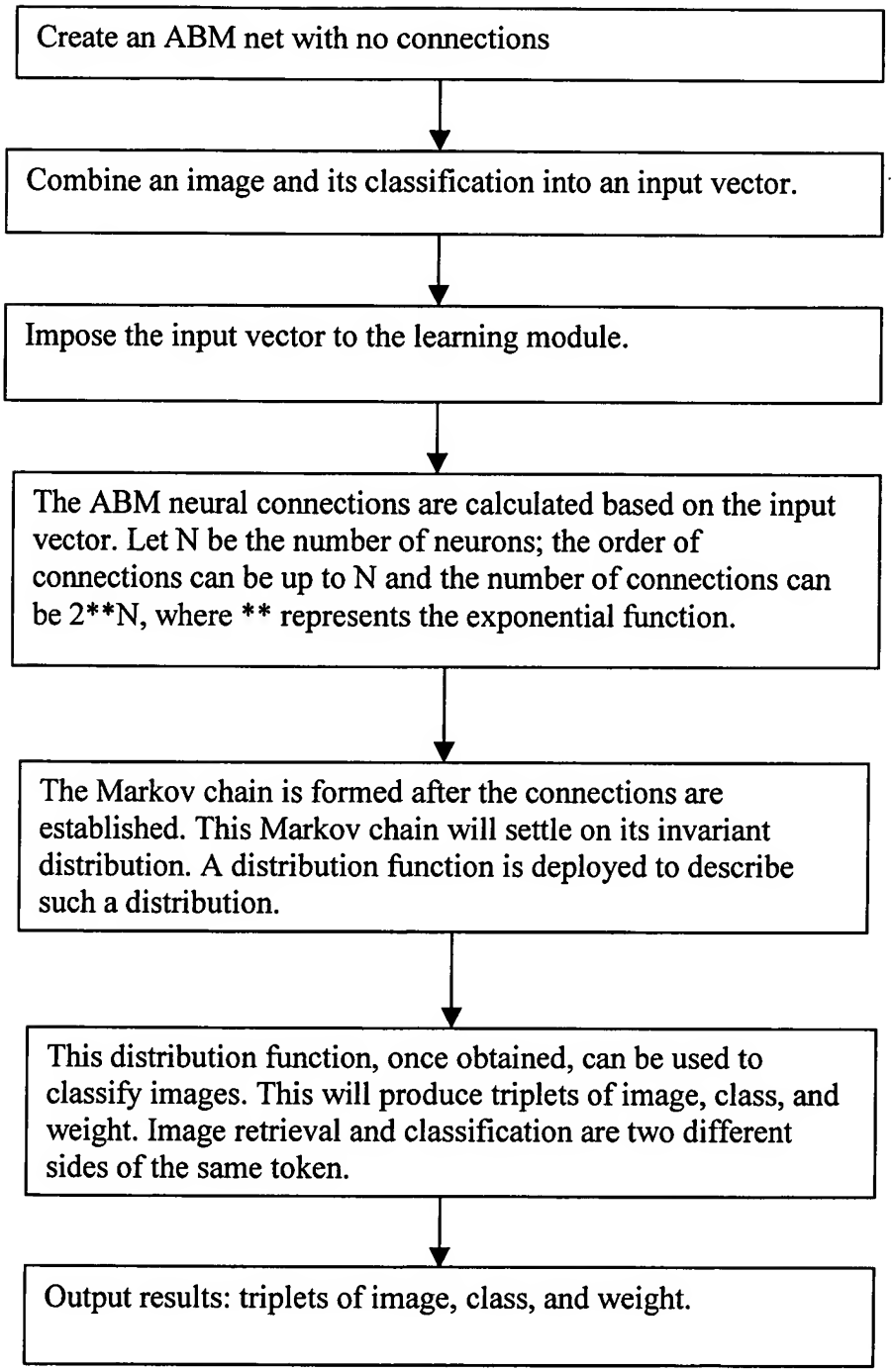

Create an ABM net with no connections
Combine an image and its classification into an input vector.
Impose the input vector to the learning module.
The ABM neural connections are calculated based on the input vector. Let N be the number of neurons; the order of connections can be up to N and the number of connections can be 2**N, where ** represents the exponential function.
The Markov chain is formed after the connections are established. This Markov chain will settle on its invariant distribution. A distribution function is deployed to describe such a distribution.
This distribution function, once obtained, can be used to classify images. This will produce triplets of image, class, and weight. Image retrieval and classification are two different sides of the same token.
Output results: triplets of image, class, and weight.

Figure 12.

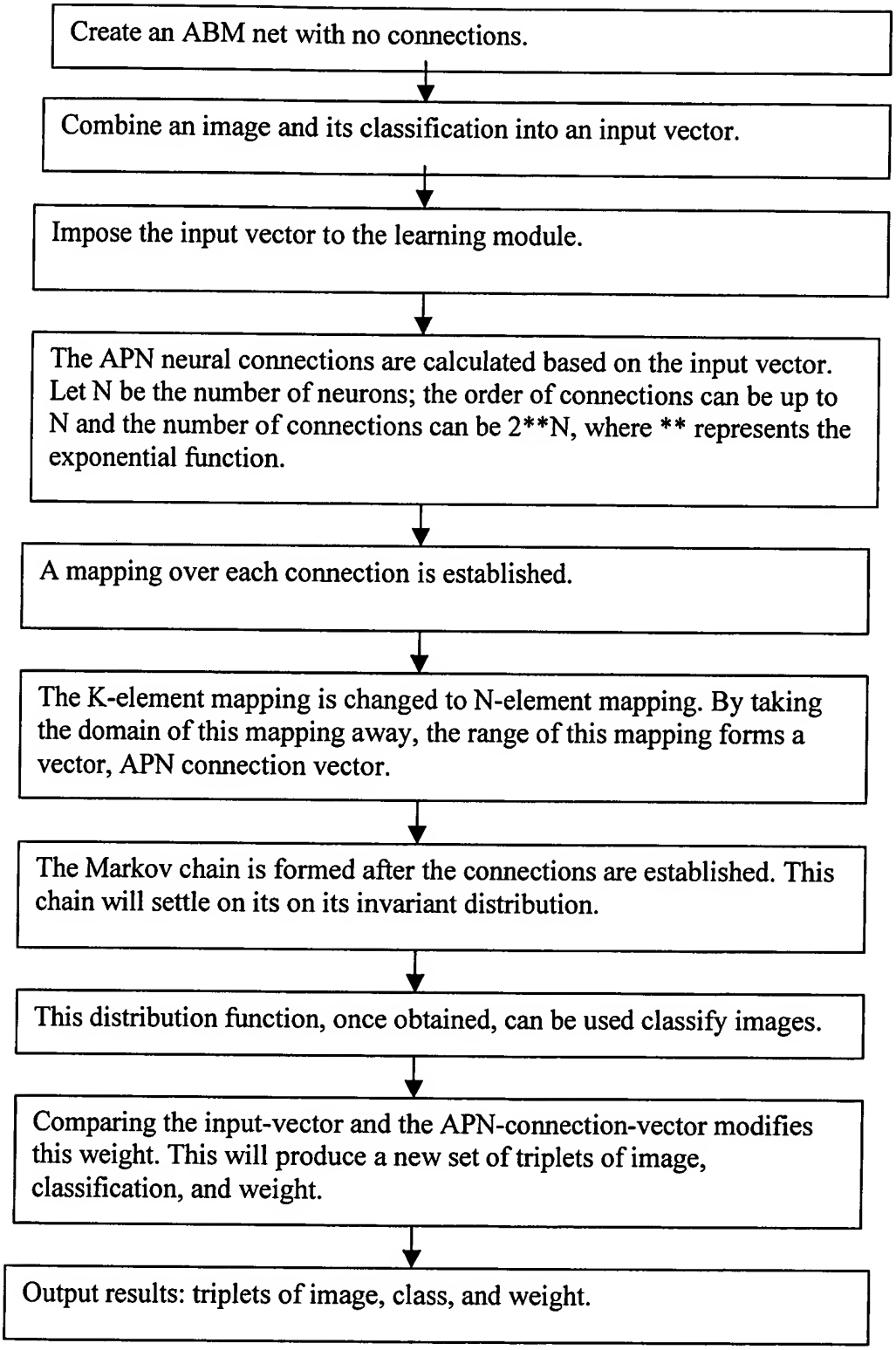
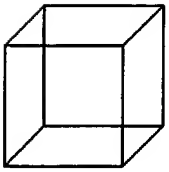
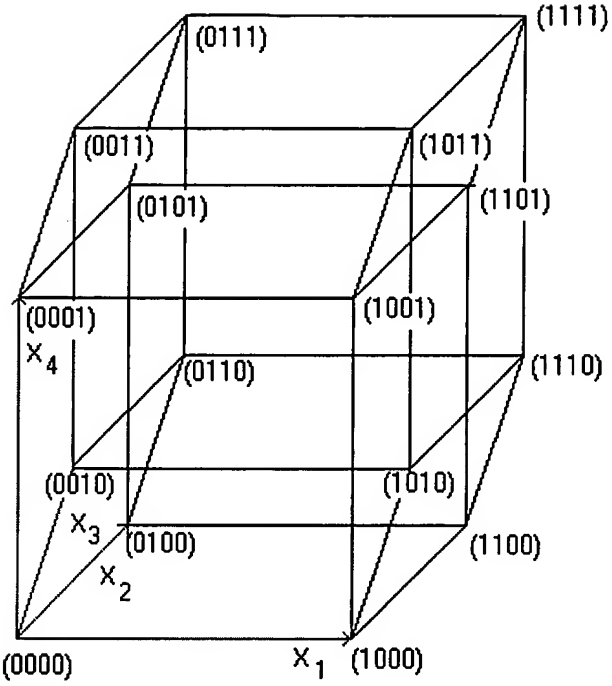

Create an ABM net with no connections.
Combine an image and its classification into an input vector.
Impose the input vector to the learning module.
The APN neural connections are calculated based on the input vector. Let N be the number of neurons; the order of connections can be up to N and the number of connections can be 2**N, where ** represents the exponential function.
A mapping over each connection is established.
The K-element mapping is changed to N-element mapping. By taking the domain of this mapping away, the range of this mapping forms a vector, APN connection vector.
The Markov chain is formed after the connections are established. This chain will settle on its on its invariant distribution.
This distribution function, once obtained, can be used classify images.
Comparing the input-vector and the APN-connection-vector modifies this weight. This will produce a new set of triplets of image, classification, and weight.
Output results: triplets of image, class, and weight.

Figure 13.

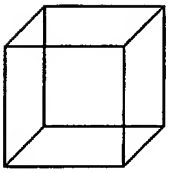


(a)

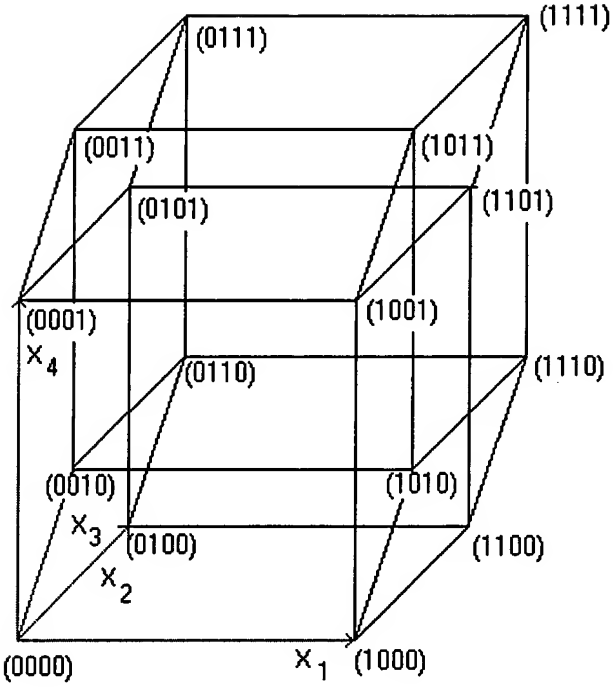

(1111)
(0111)
(0011)
(1011)
(0101)
(1101)
(0001)
(1001)
X4
(0110)
(1110)
(0010)
(1010)
X3
(0100)
(1100)
X2
(0000)
X1
(1000)

(b)

Figure 14.



(a)


(1111)
(0111)
(0011)
(1011)
(0101)
(1101)
(0001)
(1001)
X4
(0110)
(1110)
(0010)
(1010)
X3
(0100)
(1100)
X2
(0000)
X1
(1000)

(b)

Figure 15.

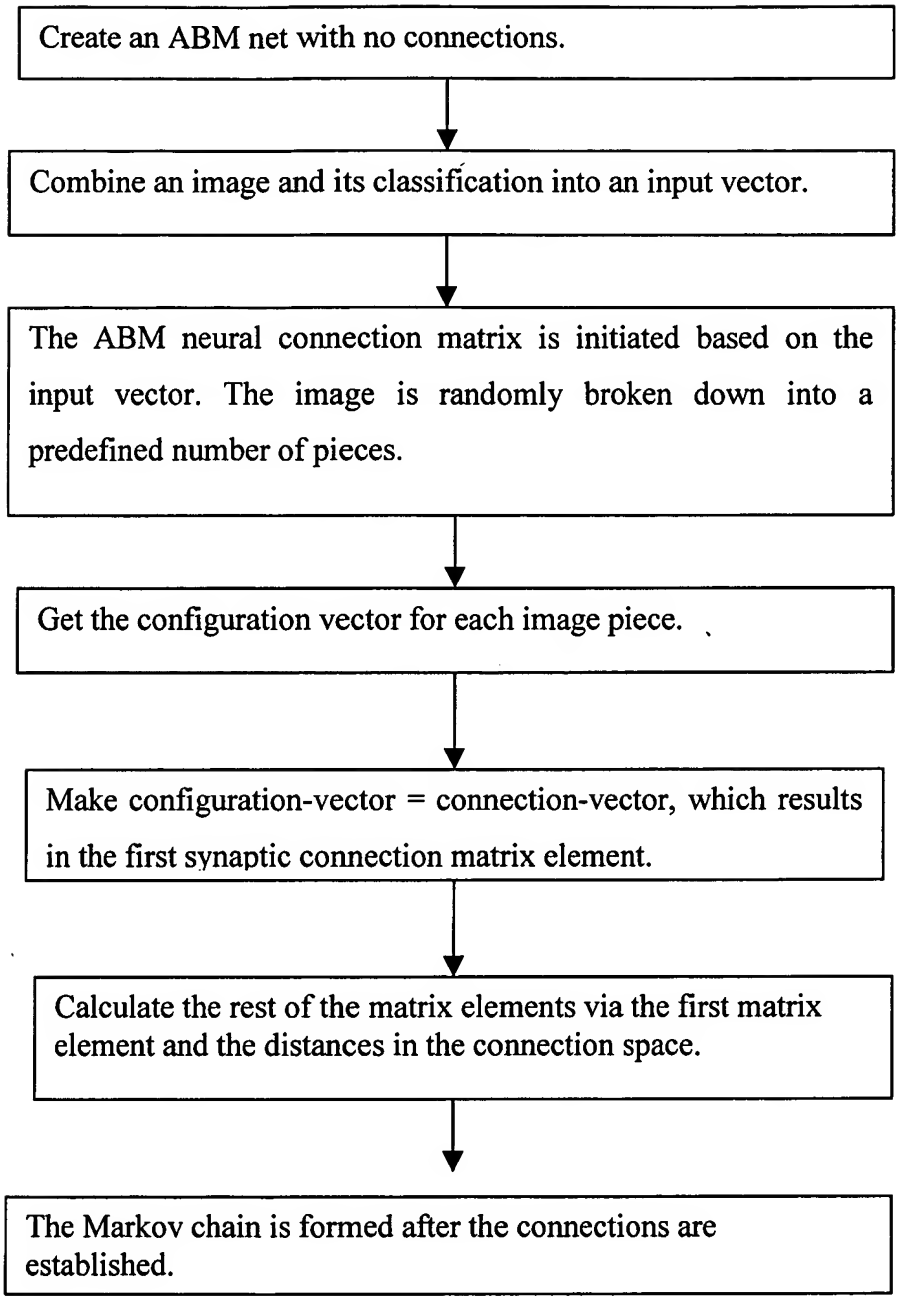

Create an ABM net with no connections.
Combine an image and its classification into an input vector.
The ABM neural connection matrix is initiated based on the input vector. The image is randomly broken down into a predefined number of pieces.
Get the configuration vector for each image piece.
Make configuration-vector = connection-vector, which results in the first synaptic connection matrix element.
Calculate the rest of the matrix elements via the first matrix element and the distances in the connection space.
The Markov chain is formed after the connections are established.

Figure 16.

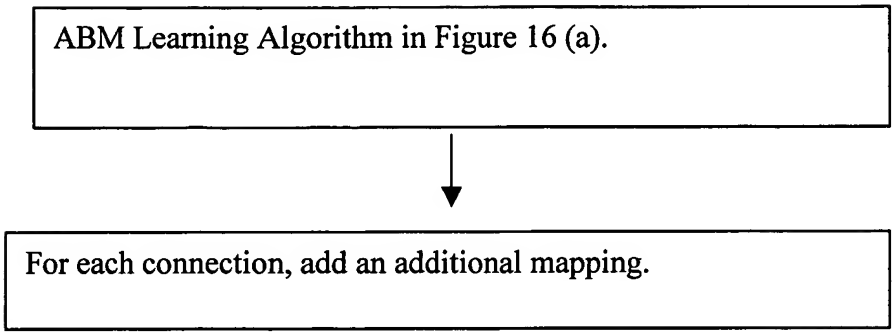

ABM Learning Algorithm in Figure 16 (a).
For each connection, add an additional mapping.

Figure 17.

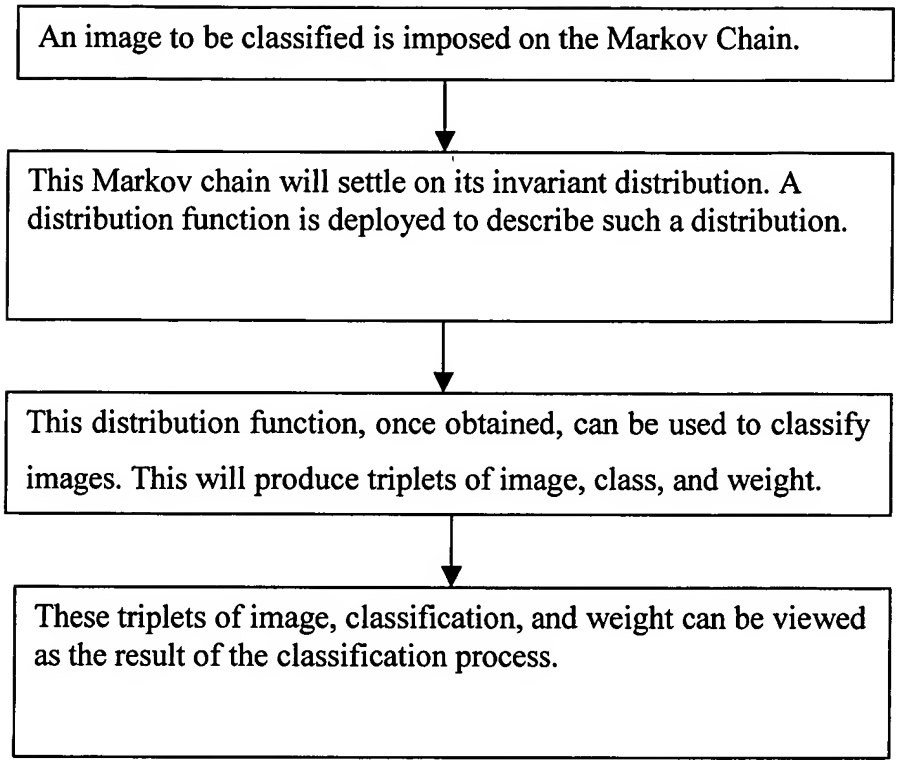

An image to be classified is imposed on the Markov Chain.
This Markov chain will settle on its invariant distribution. A distribution function is deployed to describe such a distribution.
This distribution function, once obtained, can be used to classify images. This will produce triplets of image, class, and weight.
These triplets of image, classification, and weight can be viewed as the result of the classification process.

Figure 18.

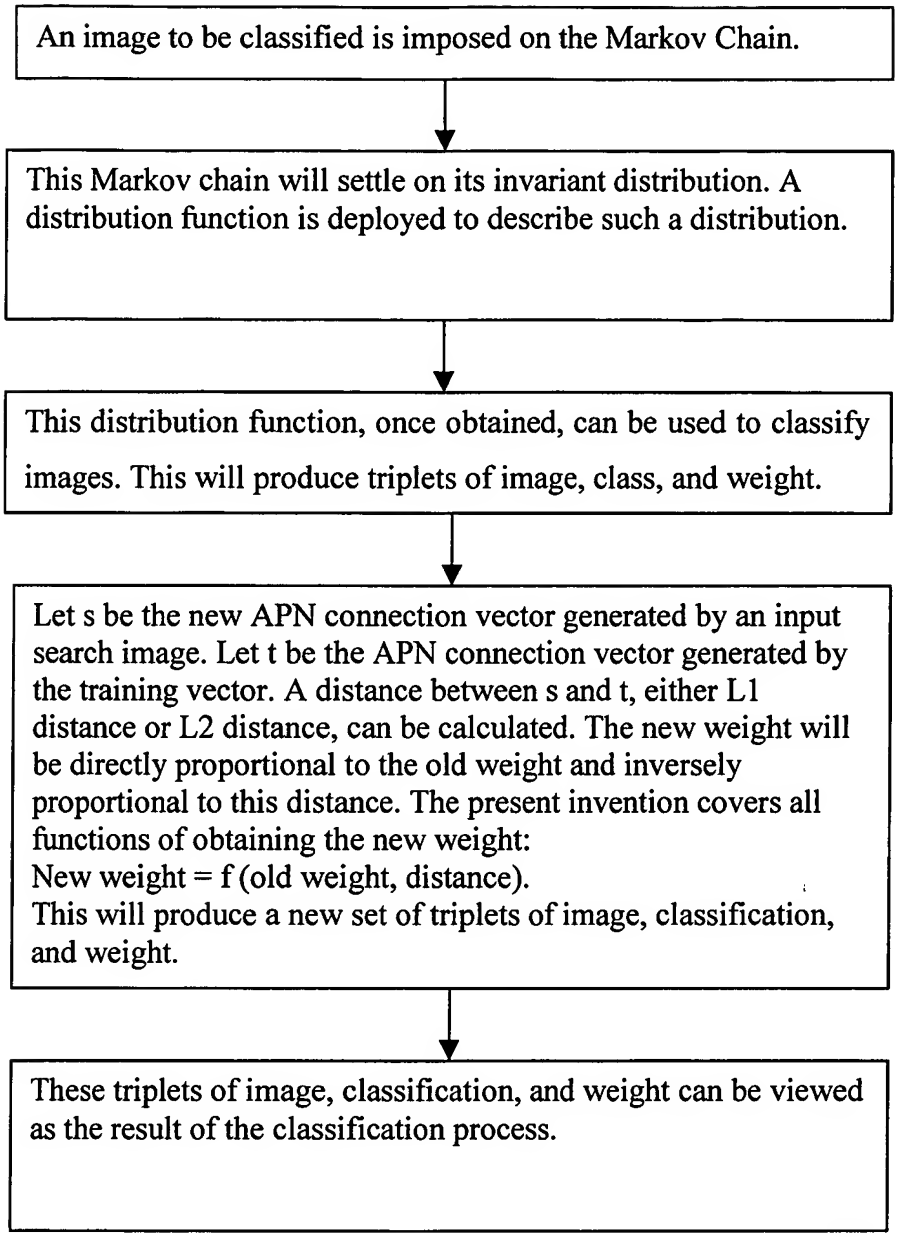

An image to be classified is imposed on the Markov Chain.
This Markov chain will settle on its invariant distribution. A distribution function is deployed to describe such a distribution.
This distribution function, once obtained, can be used to classify images. This will produce triplets of image, class, and weight.
Let s be the new APN connection vector generated by an input search image. Let t be the APN connection vector generated by the training vector. A distance between s and t, either L1 distance or L2 distance, can be calculated. The new weight will be directly proportional to the old weight and inversely proportional to this distance. The present invention covers all functions of obtaining the new weight:
New weight = f (old weight, distance).
This will produce a new set of triplets of image, classification, and weight.
These triplets of image, classification, and weight can be viewed as the result of the classification process.

Figure 19.